GETTING STARTED GUIDE

NI RF Signal Generators

This guide explains how to install, configure, test, and begin using NI RF signal generators. For more information, such as RF signal generator features and programming, refer to the *NI RF Signal Generators Help*, accessible at **Start»All Programs» National Instruments»NI-RFSG»Documentation**.

Refer to the specifications document that ships with your device for detailed specifications.

For the most current versions of documentation, visit `ni.com/manuals`. For the most current example programs, visit `ni.com/instruments`. For the latest version of NI-RFSG, visit `ni.com/rf`.

Contents

Conventions 2
1. Verifying System Requirements 4
2. Unpacking 4
3. Verifying Kit Contents 4
4. Installing the Software 6
    Install Application Development Software 6
    Install the NI-RFSG Instrument Driver 6
    Install Toolkits or Add-On Software 7
5. Installing the Hardware 7
    NI 567*x* 7
        Choose a PXI Slot Location 7
    Install the Upconverter Module 8
        Install the AWG Module 9
    NI 565*x* 9
    Cooling 11
6. Interconnecting NI 567*x* Modules 11
7. Configuring the NI 567*x* in MAX 14
    Rename Both Modules 14
    Associate an NI 54*xx* AWG Module 15

NATIONAL INSTRUMENTS

Generate a Signal Using the NI 567*x* RF Signal Generator Test Panel 15
8. Configuring the NI 565*x* in MAX 16
Generate a Signal Using the NI 565*x* RF Signal Generator Test Panel 17
9. Programming the RF Signal Generator 18
NI-RFSG Instrument Driver....18
NI-RFSG Examples....19
Appendix A: Hardware Front Panel Connectors and Indicators 20
NI 5610 RF Upconverter Module....20
NI 54*xx* AWG Module 22
NI 565*x* RF Signal Generator Module....24
Appendix B: Building a Basic NI-RFSG Application....25
Appendix C: Troubleshooting 30
Module Front Panel ACCESS LED is Off When PXI Chassis is On 30
Hardware Module Does Not Appear in MAX 30
Module Fails the Self-Test 31
Thermal Shutdown Error....31
Performance Issues Using A MXI Connection 32
Technical Support and Professional Services....32

Conventions

The following conventions are used in this manual:

»	The **»** symbol leads you through nested menus to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
♦	The ♦ symbol indicates that the following text applies only to a specific product, a specific operating system, or a specific software version.
	This icon denotes a tip, which alerts you to advisory information.
	This icon denotes a note, which alerts you to important information.
	This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
	When symbol is marked on a product, it denotes a component that may be hot. Touching this component may result in bodily injury.
AWG	Arbitrary Waveform Generator—refers to the NI-RFSG-supported arbitrary waveform generator hardware module used in NI 567*x* devices.

bold	Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.
italic	Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.
module	Refers to the NI 565*x* hardware, or to one of the two hardware components of the NI 567*x* RF signal generator: the AWG PXI module or the upconverter PXI module.
`monospace`	Text in this font denotes text or characters that you enter from the keyboard. This font is also used for the proper names of paths, directories, programs, functions, operations, variables, and filenames.
`monospace italic`	Italic text in this font denotes text that is a placeholder for a word or value that you must supply.
MXI	Multisystem Extension Interface, a high-speed serial interface bus designed to connect computers to PXI, or to connect multiple PXI chassis. In this document, MXI refers to NI MXI-3, MXI-4, or MXI-Express systems.
NI 54*xx*	NI 54*xx* refers to the AWG module included with the NI 5610 upconverter module to make up the NI 567x. Supported AWG modules include the NI PXI-5421 and NI PXI-5441.
NI 565*x*	NI 565*x* refers to the NI PXI-5650, NI PXI-5651, or NI PXI-5652 RF signal generators. These devices consist of a single PXI hardware module.
NI 567*x*	NI 567*x* refers to the NI PXI-5670 or NI PXI-5671 RF signal generators. The NI 567*x* instruments are comprised of an upconverter hardware module, an AWG hardware module, and the NI-RFSG instrument driver. There is no single physical device labeled “NI PXI-5670” or “NI PXI-5671.”
Platform	Text in this font denotes a specific platform and indicates that the text following it applies only to that platform.
PLL	Phase-Locked Loop—an electronic circuit that controls an oscillator so that the circuit maintains a constant phase angle relative to a reference signal.
RF	Radio Frequency—refers to the signal output from the RF OUTPUT connector on the RF signal generator device front panels.
upconverter	A device that frequency-translates IF signals to center around a specified RF frequency—refers to an NI 5610 2-slot RF upconverter hardware module.

1. Verifying System Requirements

Your system must meet certain requirements to use NI RF vector signal generators. For more information on minimum system, recommended system, and supported application development environments (ADEs), refer to the *NI-RFSG Instrument Driver Readme*, which is available on the NI-RFSG CD.

After you install NI-RFSG, you can access the *NI-RFSG Instrument Driver Readme* at **Start»All Programs»National Instruments»NI-RFSG» Documentation**.

2. Unpacking

RF signal generator hardware modules ship in antistatic packages to prevent damage from electrostatic discharge (ESD). Because ESD can damage several components of the RF signal generator, store all RF signal generator hardware modules in the antistatic envelopes when not in use.

Caution *Never* touch exposed connector pins.

To avoid damage when handling RF signal generator hardware modules, take the following precautions:

- Ground yourself using a grounding strap or by touching a grounded object.
- Touch the antistatic package to a metal part of the computer chassis before removing the hardware module from the package.

Remove each hardware module from the package and inspect it for loose components or any signs of damage. Notify NI if either hardware module appears damaged in any way. Do *not* install a damaged module into the system.

3. Verifying Kit Contents

Verify that the kit contains the following items required to set up and use the NI RF signal generator:

- ❑ CD, which installs the following software components:
  - NI-RFSG instrument driver, including NI-RFSG examples.
  - Hardware and software electronic documentation:
    - *NI RF Signal Generators Help* (online help)
    - *NI RF Signal Generators Getting Started Guide* (PDF)

- Specifications documents for your device (PDF)
- Hardware user manual for your device (PDF)

❑ Other included documents:
  – The specifications document for your RF signal generator
  – *NI RF Signal Generators Getting Started Guide* (this document)
  – *Read Me First: Safety and Radio-Frequency Interference*
  – *Maintain Forced-Air Cooling Note to Users*

❑ Either an NI 567*x* or NI 565*x* device. The components for each device are described in Tables 1 and 2, respectively.

Table 1. NI 567*x* Required Parts Inventory and Replacement Part Numbers

Hardware Component	Replacement Part Number
Two hardware modules: • NI 5610 wideband RF upconverter module • NI 5421 or NI 5441 AWG module	 189718D-01 778697-02 (NI PXI-5421); 779058-02 (NI PXI-5441)
Two semi-flexible SMA-to-SMB coaxial cables	190846A-01
1/8-in. combination Phillips/flathead screwdriver	772006-01
Plastic collars (cable wrenches) for gripping the coaxial cable hex connectors	746016-01
NI PXI-1042 chassis with controller (not included)	188079B-01
100 N-cm SMA torque wrench (not included)	N/A

Table 2. NI 565*x* Required Parts Inventory and Replacement Part Numbers

Hardware Component	Replacement Part Number
NI PXI-5650	191967C-01
NI PXI-5651	191967C-02
NI PXI-5652	191967C-03
1/8-in. combination Phillips/flathead screwdriver	772006-01
NI PXI-1042 chassis with controller (not included)	188079B-01
100 N-cm SMA torque wrench (not included)	N/A

4. Installing the Software

This section describes the software installation process for NI RF signal generators.

Install Application Development Software

You can create applications for RF signal generators using application development environments (ADE) such as LabVIEW, LabWindows™/CVI™, or other development environments.

If you have not already installed an ADE, follow the instructions in the product documentation to install your ADE now.

Install the NI-RFSG Instrument Driver

Complete the following steps to install the contents of the *NI-RFSG* CD:

1. Insert the *NI-RFSG* CD. The NI-RFSG installer should open automatically. If not, select **Start»Run**, and enter `x:\setup.exe`, where *x* is the letter of the CD drive.
2. Follow the instructions in the installation prompts to complete the NI-RFSG installation. For troubleshooting and operating system-specific instructions, refer to the Hardware Installation Wizard at `ni.com/support/install`.

   (Windows Vista) Users may see access and security messages during installation. Accept the prompts to complete the installation.
3. When the installer completes, a dialog box appears that asks if you want to restart, shut down, or restart later. Select **Restart**.

Install Toolkits or Add-On Software

Optional add-on software, such as the Modulation Toolkit, extends the generation capability of NI RF signal generators for modulation-domain and frequency-domain applications. Install any toolkits or add-on software you intend to use with the RF signal generator after installing the *NI-RFSG* CD.

Note You must install the NI-RFSG instrument driver before installing the Modulation Toolkit add-on software in order to properly install the Modulation Toolkit examples for NI-RFSG. If the Modulation Toolkit is already installed, repeat or repair the Modulation Toolkit installation after installing NI-RFSG.

5. Installing the Hardware

NI PXI modules are sensitive instruments that should be handled carefully. Do not expose the module to temperatures or humidity beyond the rated maximums. Keep the module free of dust by cleaning with compressed air only. Do not clean the module with any solvents or liquids. For more information about module cooling, refer to the guidelines in the *Maintain Forced-Air Cooling Note to Users* included with the NI RF signal generator.

NI 567*x*

Choose a PXI Slot Location

Installation of the NI 567*x* hardware requires three vacant PXI slots—two slots for the NI 5610 upconverter module and one slot for the NI 54*xx* AWG module. The NI 54*xx* AWG module must be installed in the adjacent slot immediately to the right of the NI 5610 upconverter module to allow use of the included SMA-to-SMB coaxial cables.

The NI 5610 upconverter module onboard frequency reference can drive the PXI backplane clock *only* if the upconverter module is installed in PXI Slot 2. When the NI 5610 is installed in PXI Slot 2, you can configure it to lock the PXI backplane to the NI 5610 onboard oven-controlled crystal oscillator (OCXO) or to an external frequency source (connected to the REF IN connector on the NI 5610 module front panel).

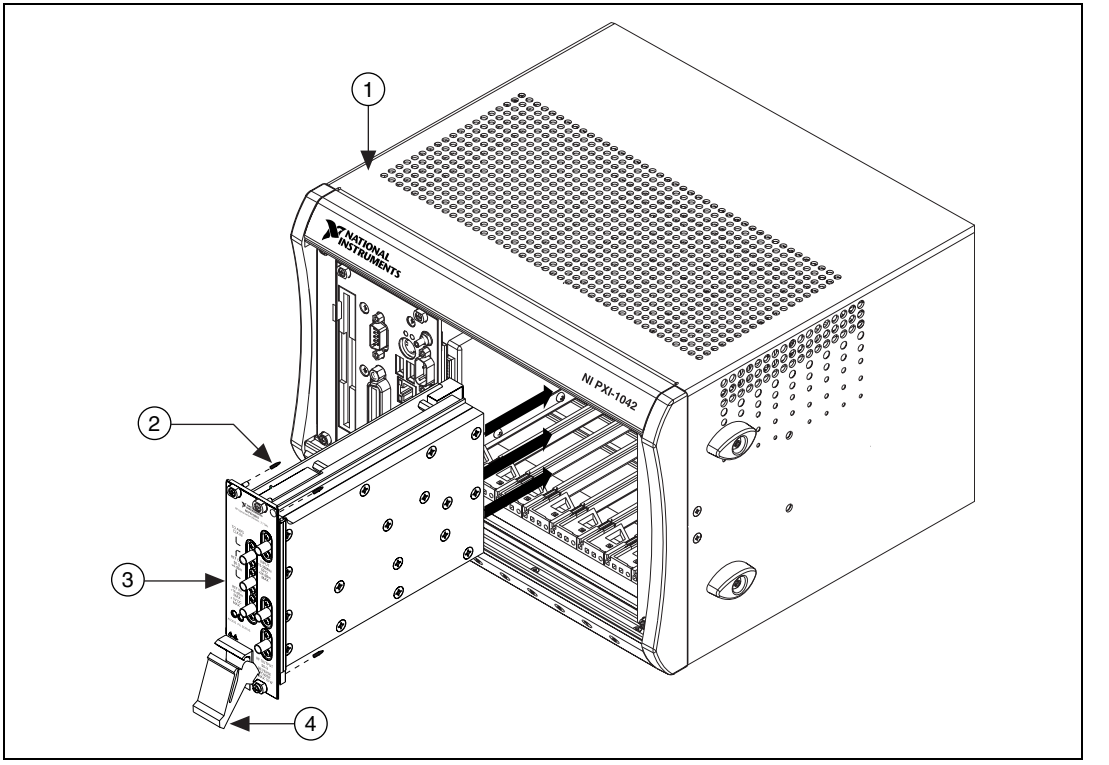
Install the Upconverter Module

Install the NI 5610 RF upconverter module by completing the following steps:

1. Verify that NI-RFSG is installed on your system.
2. Power off the PXI chassis.
3. Insert the NI 5610 upconverter module as shown in Figure 1. This module requires two vacant PXI slots.

Note The NI 5610 *must* be installed in PXI Slot 2 to optionally drive the PXI backplane with the NI 5610 onboard OCXO or an external reference signal.

   a. Remove the black plastic protectors from the four captive screws in the module front panel.
   b. Slide the NI 5610 into an available PXI slot until the ejector handle locks in the upward position.
   c. Tighten the four screws in the module front panel.



1 PXI Chassis	3 NI 5610 Upconverter Module
2 Rubber Screw Covers	4 Ejector Handle in Down Position

Figure 1. Install the NI 5610 Upconverter Module

Install the AWG Module

Install the NI 54*xx* AWG module by completing the following steps:

1. Ensure that the PXI chassis is powered off.
2. Install the NI 54*xx* AWG module by completing the following steps:
   a. Remove the black plastic protectors from the two captive screws in the module front panel.
   b. Slide the NI 54*xx* AWG module into the slot *immediately* to the right of the NI 5610 upconverter module. Press firmly until the ejector handle locks in the upright position.
   c. Tighten both screws in the NI 54*xx* AWG module front panel.

Continue with the procedure in section *6. Interconnecting NI 567x Modules*.

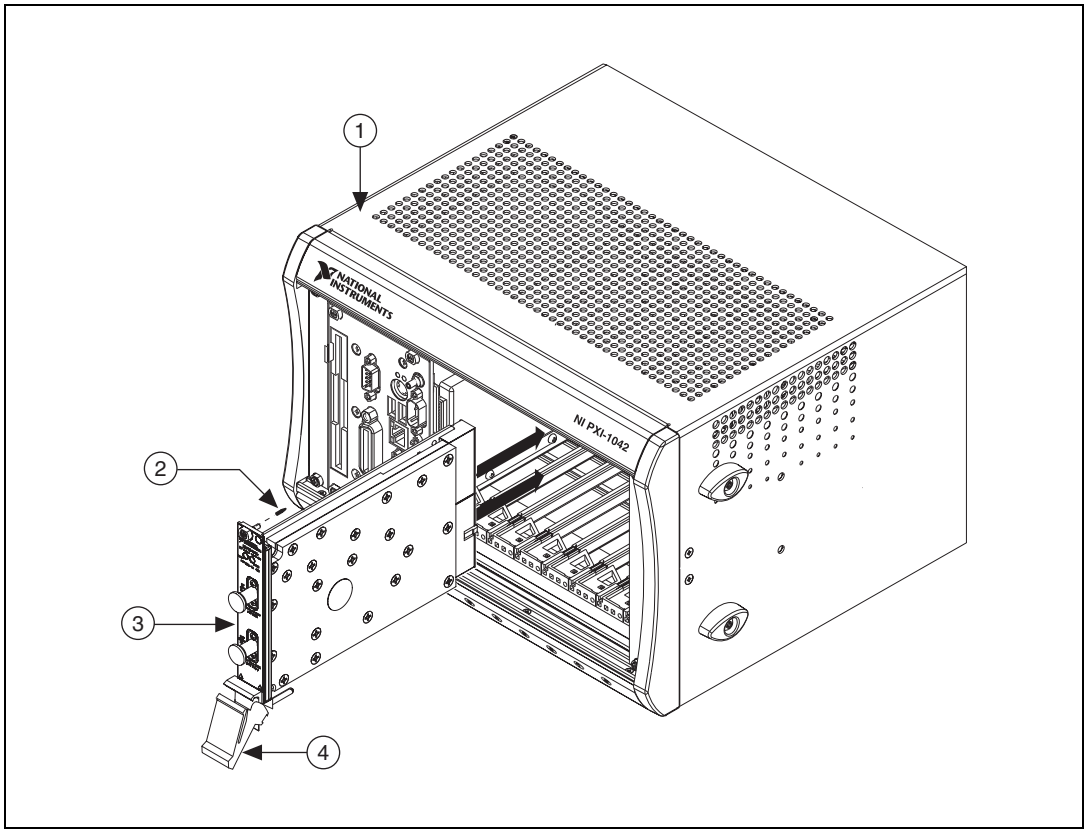
NI 565*x*

You can install the NI 565*x* RF signal generator in any PXI slot marked with a peripheral slot compatibility glyph (a circle containing the slot number).

To install the NI 565*x*, complete the following steps:

1. Power off and unplug the PXI chassis before installing a PXI device.
2. If the PXI chassis has multiple fan speed settings, ensure that the fans are set to high.
3. Position the PXI chassis so that inlet and outlet vents are not obstructed. For more information, refer to the chassis documentation.
4. Ensure that the ejector handle is in the unlatched (downward) position.

5. Holding the device by the ejector handle, slide it into an empty slot, ensuring that the base card (the card on the left when you look at the front of the device) engages with the card guides in the chassis, as shown in Figure 2.



1 PXI Chassis	3 NI 565*X* RF Signal Generator Module
2 Rubber Screw Cover	4 Ejector Handle in Down Position

Figure 2. Install the NI 565*x* RF Signal Generator Module

6. Slide the device completely into the chassis and latch by pulling up on the ejector handle.
7. Tighten the captive screw at the top of the device front panel. Performance may suffer if the screw is not tightened properly.
8. Verify that the PXI chassis fans are operable and free of dust and other contaminants restricting airflow.
9. Before operating the device, cover all empty PXI slots using blank PXI filler panels.
10. Plug in and power on the PXI chassis.

Cooling

When installing the hardware, refer to the guidelines in the *Maintain Forced-Air Cooling Note to Users* included with the NI RF signal generator to ensure that the device can cool itself effectively.

Caution Inadequate air circulation could cause the temperature inside the chassis to rise above the optimal operating temperature for the RF signal generator, potentially causing thermal shutdown, shorter lifespans, or improper performance.

- NI 567*x*

  Under conditions of proper air flow and 25 °C (63 °F) ambient temperatures, the NI 5610 upconverter module operates at internal temperatures of approximately 45 °C (113 °F), the NI 5421 module at approximately 51 °C (124 °F), and the NI 5441 module at approximately 58 °C (136 °F).

- NI 565*x*

  Under conditions of proper air flow and 25 °C (63 °F) ambient temperatures, the NI 565*X* operates at internal temperatures of approximately 38 °C (100 °F).

Hot Surface If the RF signal generator has been in use, it may exceed safe handling temperatures and cause burns. Allow the RF signal generator to cool before removing it from the PXI chassis.

Tip NI recommends that you install PXI slot blockers between the RF signal generator and adjacent hardware modules to maximize cooling air flow. The PXI Chassis Slot Blocker Kit, part number 778678-01, is available for purchase at `ni.com`.

If you are setting up an NI 565*x* signal generator, proceed to section *8. Configuring the NI 565x in MAX*.

6. Interconnecting NI 567*x* Modules

The NI 567*x* hardware modules interconnect through the front panels. Complete the following steps to interconnect the NI 567*x* hardware module front panel connectors as shown in Figure 3.

1. Connect the INPUT connector on the NI 5610 upconverter module to the CH 0 connector on the NI 54*xx* AWG module.
2. Connect the TO AWG CLK IN connector on the NI 5610 upconverter module to the CLK IN connector on the NI 54*xx* AWG module.

Note Published NI 567*x* RF signal generator specifications assume use of the included cables. Substituting different cables may affect performance.

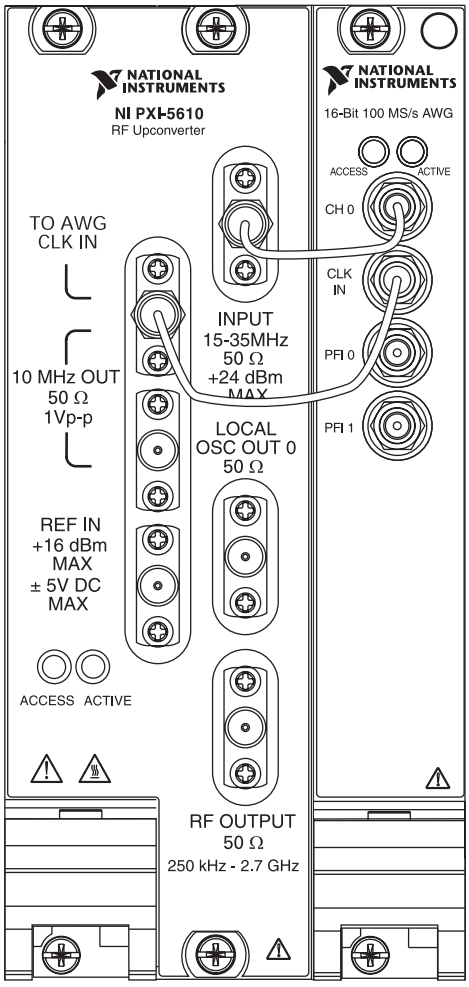
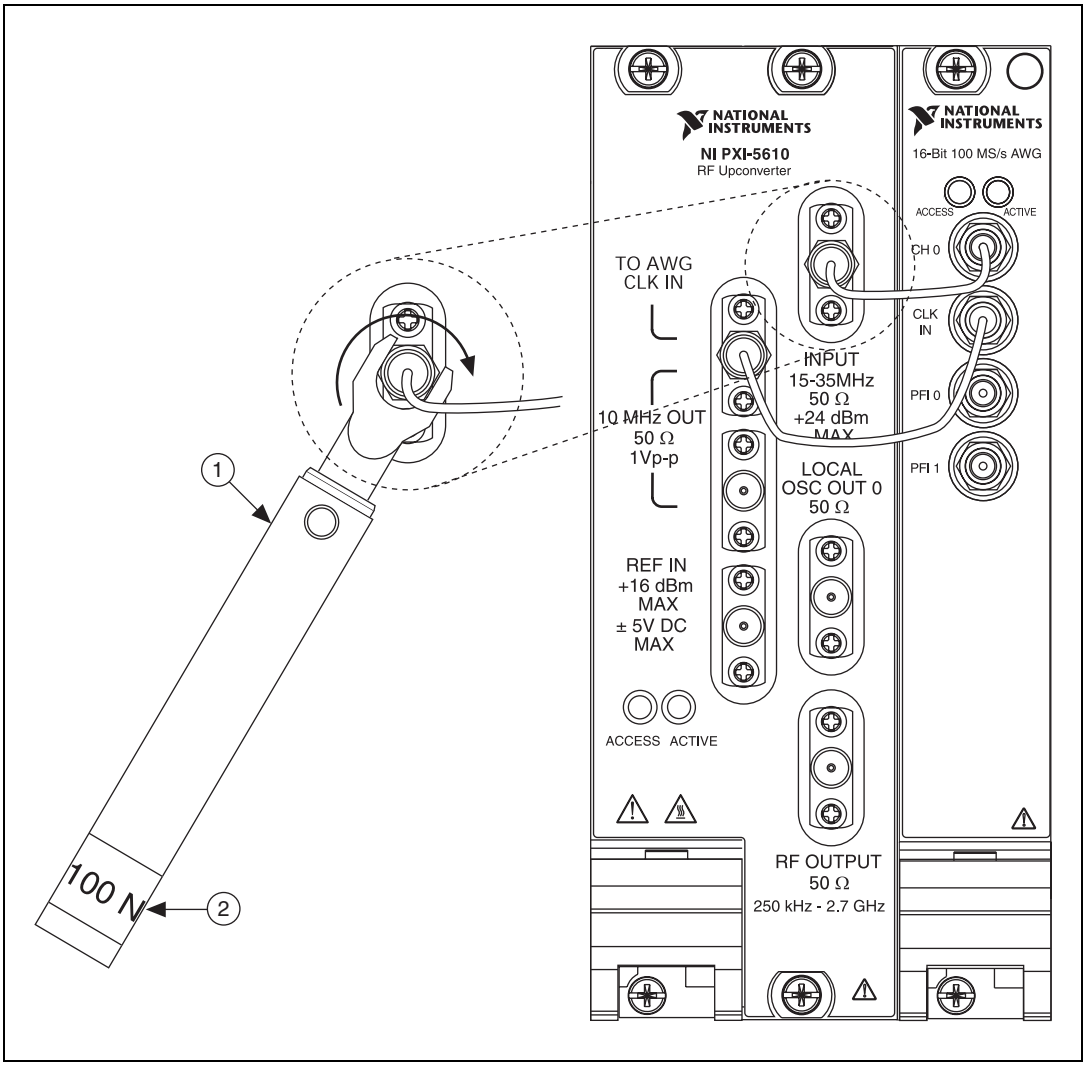


Figure 3. Proper NI 567*x* Front Panel Interconnection

3. Carefully tighten all SMA connectors to 100 N-cm using an SMA torque wrench (not included), as shown in Figure 4. Tighten only until the wrench clicks.

Note Incorrect torque at SMA connections can degrade signal fidelity, PLL performance, and insertion loss. Use an SMA torque wrench to ensure all SMA connections are properly torqued to 100 N-cm.



1	100 N-cm SMA Torque Wrench	2	Apply Force Here Until Wrench Clicks

Figure 4. Torque All SMA Connectors to 100 N-cm

4. Power up the PXI chassis and controller system.
5. Verify that the ACCESS LEDs on both modules are illuminated. If the LEDs are not illuminated, refer to *Appendix C: Troubleshooting*.

7. Configuring the NI 567*x* in MAX

Use Measurement & Automation Explorer (MAX) to configure your National Instruments hardware. MAX informs other programs about which devices reside in the system and how they are configured. MAX is automatically installed with the NI-RFSG driver.

Note MAX treats the NI 5610 upconverter module and the NI 54*xx* AWG module as separate but associated devices. The MAX association is necessary for transparent operation of both modules as a single instrument (the NI 567*x*) using the NI-RFSG driver.

To use MAX to configure, self-test, associate, and generate signals with the NI 567*x*, complete the following steps:

1. Launch MAX by navigating to **Start»All Programs»National Instruments»Measurement & Automation** or by clicking the MAX desktop icon.
2. In the Configuration pane, double-click **Devices and Interfaces** to see the list of installed devices.
3. Expand the **NI-DAQmx Devices** folder. You will see a list of installed devices that includes the NI PXI-5610 upconverter module and an AWG module.

Note If you do not see both the NI PXI-54*xx* AWG module and the NI PXI-5610 upconverter module listed, refer to *Appendix C: Troubleshooting*.

Rename Both Modules

MAX allows you to rename both NI 567*x* hardware modules. The MAX name is used in software to operate the NI 567*x* hardware resources. You do not have to change the module names from the default, but doing so can make programming easier.

To rename both NI 567*x* hardware modules, complete steps 4 through 10. If you do not wish to rename the modules, skip to step 11.

4. Right-click the NI 5610 upconverter module and select **Rename** from the shortcut menu.
5. Enter the new name for the NI 5610 upconverter module.

Note The device must consist only of alphanumeric and underscore characters.

6. Click **OK**.
7. Right-click the AWG module and select **Rename** from the shortcut menu.
8. Enter the new name for the AWG module.
9. Click **OK**.
10. Verify that the new names for both modules are displayed before proceeding to step 11.

Associate an NI 54*xx* AWG Module

You must create a MAX association between the NI 5610 upconverter module and the NI 54*xx* AWG module to control both hardware modules as a single RF signal generator. Complete steps 11 through 13 to make this association.

11. Right-click **NI PXI-5610** and select **Properties**.
12. In the NI 5610 Device Properties dialog box, use the drop-down listbox to specify the NI 54*xx* AWG module that is connected to the NI 5610 by front panel coaxial cables. Refer to section *6. Interconnecting NI 567x Modules* for more information.

Tip If you rename the NI 54*xx* AWG module after association, you must repeat the association. Association between NI 567*x* hardware modules is lost when a previously associated AWG module is renamed.

13. Click **OK** to close the dialog box.

Generate a Signal Using the NI 567*x* RF Signal Generator Test Panel

To verify your device configuration, use the NI-RFSG test panel in MAX to generate a simple signal using the RF signal generator hardware. The NI-RFSG test panel tests both NI 567*x* hardware modules as a single instrument. Complete steps 14 through 19 to use the RF signal generator test panel.

Note This test requires front panel interconnection, as shown in Figure 3, and the association of an NI 54*xx* AWG module with the NI 5610 upconverter module as described in steps 11 through 13.

14. Right-click the NI PXI-5610 upconverter module and select **Test Panels**.
15. In the NI PXI-567*x* tab of the Test Panels dialog box, specify a frequency and a power level for signal generation.

Caution Running the test panel outputs a signal from the RF OUTPUT front panel connector. Disconnect any equipment that can be damaged by the test signal prior to running the test panel.

16. The test panel allows you to verify that the device is operating properly. Click **Start** to begin signal generation. During signal generation the ACTIVE LEDs on both NI 567*x* hardware modules are activated.

Note If either ACTIVE LED does not illuminate or if the RF signal generator test panel generates an error, refer to *Appendix C: Troubleshooting*.

17. Click **Stop** to stop waveform generation.
18. Click **Close** to return to MAX.
19. Exit MAX.

You have completed setup, configuration, and testing of the NI 567*x* RF Signal Generator.

8. Configuring the NI 565*x* in MAX

Use Measurement & Automation Explorer (MAX) to configure your National Instruments hardware. MAX informs other programs about which devices reside in the system and how they are configured. MAX is automatically installed with the NI-RFSG driver.

To use MAX to configure, self-test, associate, and generate signals with the NI 565*x*, complete the following steps:

1. Launch MAX by navigating to **Start»All Programs»National Instruments»Measurement & Automation** or by clicking the MAX desktop icon.
2. In the Configuration pane, double-click **Devices and Interfaces** and expand the **NI-DAQmx Devices** folder. You will see a list of installed devices that includes the NI PXI-565*x* RF signal generator module.
3. Check that your device appears under **Devices and Interfaces**. If your device does not appear, press <F5> to refresh the view in MAX. If the NI 565*x* is still not recognized, refer to `ni.com/support/install`.

Note If you are using a MXI interface to control a PXI chassis and encounter performance or initialization issues, refer to your MXI documentation to ensure that the MXI interface is properly set up. Software optimization might be necessary. For MXI-3 optimization, select **Start»All Programs»National Instruments MXI-3»MXI-3 Optimization**. MXI-4 optimization is performed automatically by the MXI-4 hardware.

4. Perform a device self-test to verify installation by right-clicking the NI 565*x* device and selecting **Self-Test**. A dialog box appears and indicates whether the device passed the test. When the self-test finishes, a message indicates successful verification or if an error occurred. If an error occurs, refer to `ni.com/support/install` for troubleshooting information.
5. Record the device number or device name assigned to the device. You need this number when programming the device. The assigned device name is appended to the device in its configuration tree label. For example, after installing the NI 565*x*, the device configuration tree label may appear as `NI PXI-565X`: "`Dev1`", where `Dev1` is the device name. When developing your application, the resource name for your device is the device name MAX assigned to the device.

Note You can rename NI-DAQmx devices by right-clicking the device and selecting **Rename**.

Generate a Signal Using the NI 565*x* RF Signal Generator Test Panel

To verify your device configuration, use the NI-RFSG test panel in MAX to generate a simple signal using the NI 565*x* RF signal generator hardware. Complete steps 1 through 6 to use the RF signal generator test panel.

1. Right-click the NI PXI-565*x* RF signal generator module and select **Test Panels**.
2. In the Test Panels dialog box, specify a frequency and a power level for signal generation.

Caution Running the test panel outputs a signal from the RF OUTPUT front panel connector. Disconnect any equipment that can be damaged by the test signal prior to running the test panel.

3. The test panel allows you to verify that the NI 565*x* device is operating properly. Click **Start** to begin signal generation. During signal generation the ACTIVE LED on the NI 565*x* hardware module is activated.

Note If the LED does not illuminate or if the RF signal generator test panel generates an error, refer to *Appendix C: Troubleshooting*.

4. Click **Stop** to stop waveform generation.
5. Click **Close** to return to MAX.
6. Exit MAX.

You have completed setup, configuration, and testing of the NI 565*x* RF Signal Generator.

9. Programming the RF Signal Generator

You can generate signals with the NI RF signal generator using the NI-RFSG instrument driver. You also can run the NI-RFSG examples to demonstrate the functionality of the RF signal generator.

NI-RFSG Instrument Driver

The NI-RFSG driver configures and operates the RF signal generator hardware, performs waveform programming and generation, and basic modulation tasks using LabVIEW VIs or LabWindows/CVI functions. In the case of NI 567*x* RF signal generators, the NI-RFSG instrument driver transparently operates the NI 5610 upconverter module and the NI 54*xx* AWG module as a single instrument.

Optional add-on software available from NI, including the Modulation Toolkit and the Spectral Measurements Toolkit, extends the capability of NI RF signal generators to include additional modulation-domain and frequency-domain tasks. The RF signal generator hardware-software architecture is shown in Figure 5.

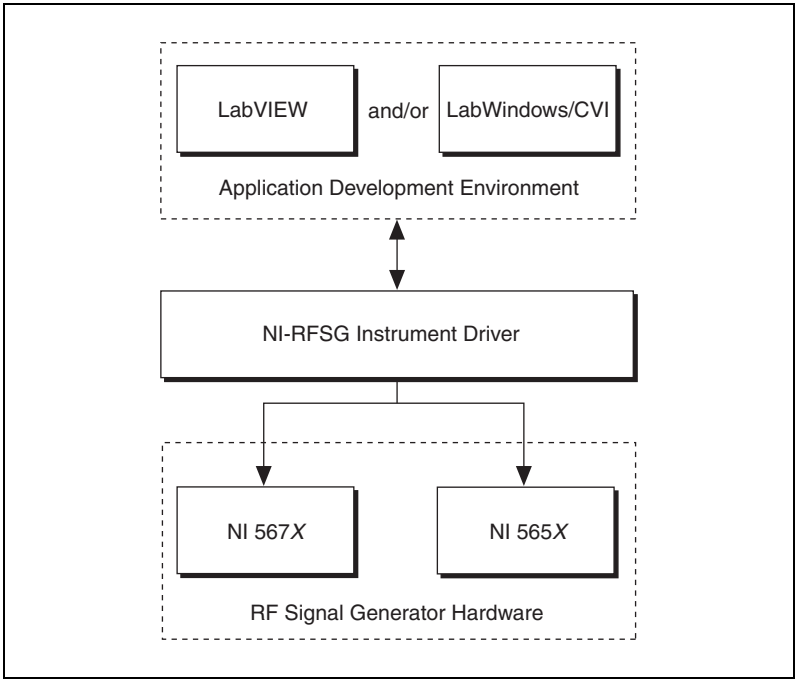


Figure 5. RF Signal Generator Hardware-Software Architecture

Note Refer to the *NI RF Signal Generators Help* for more information on RF signal generator hardware/software architecture. The *NI RF Signal Generators Help* is available at **Start»All Programs»National Instruments»NI-RFSG»Documentation**.

NI-RFSG Examples

NI-RFSG includes several example applications for both LabVIEW and LabWindows/CVI. These examples serve as interactive tools, programming models, and building blocks in your own applications. For more information on NI-RFSG examples and locations, refer to the *NI-RFSG Instrument Driver Readme*, which is available on the NI-RFSG CD.

Appendix A: Hardware Front Panel Connectors and Indicators

This appendix describes the connectors and LED indicators on the front panels of both NI RF signal generator hardware modules. All inputs and outputs are AC-coupled.

NI 5610 RF Upconverter Module

The NI 5610 RF upconverter module front panel contains six connectors and two multicolor LEDs, as shown in Figure 6.

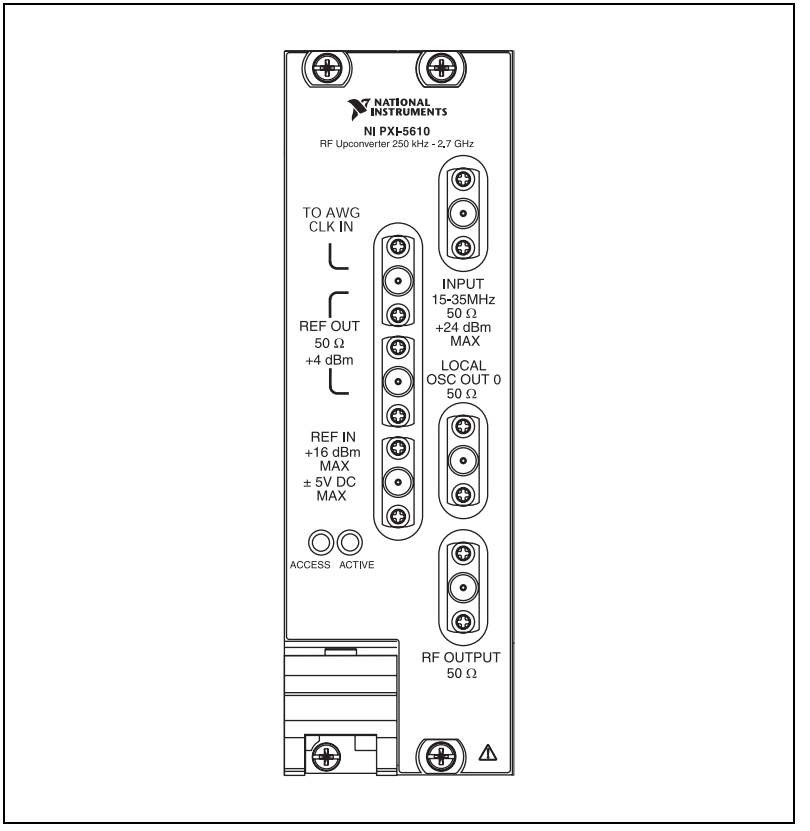


Figure 6. NI 5610 Upconverter Module Front Panel

Table 3. NI 5610 RF Upconverter Module Front Panel Connectors

Connector	Use
10 MHz OUT (TO AWG CLK IN)	Output terminals for replications of the upconverter 10 MHz frequency reference signal, which is useful for driving other devices. Each replication is 180° out-of-phase with the other. The output signal at these connectors is always on and cannot be disabled. Connect the TO AWG CLK IN connector to the CLK IN connector on the NI 54*xx* module front panel.
10 MHz OUT	
REF IN	Routes an external frequency reference signal that can be propagated to the PXI backplane. The NI 5610 can lock to this signal.
IF INPUT	Routes the IF signal from the NI 54*xx* AWG module for frequency translation. Connect to the CH 0 output on the NI 54*xx* front panel.
LOCAL OSC OUT 0	Output terminal for the auxiliary local oscillator signal.
RF OUTPUT	Output terminal for the upconverted signal at the requested RF frequency.

Table 4. NI 5610 RF Upconverter Module Front Panel LEDs

LED	Indications
ACCESS	Indicates the basic hardware status of the NI 5610 module. This LED functions identically to the ACCESS LED on the AWG module front panel. OFF—The module is not yet functional or has detected a problem with a PXI power rail. AMBER—The module is being accessed. GREEN—The module is ready to be programmed.
ACTIVE	Indicates the status of the NI 5610 PLLs. OFF—The module is in an uninitialized state; there is no error. AMBER—The module PLLs are attempting to lock. GREEN—The module is in a ready state; applicable PLLs are locked and the reverse power protection circuit is closed. RED—The module has detected an error state; this state may indicate an overload (reverse power protection circuit is open), lock failure in an applicable PLL, a self-test or calibration failure, or a thermal shutdown condition.

NI 54*xx* AWG Module

The front panel of the NI 54*xx* AWG module contains four connectors and two multicolor LEDs, as shown in Figure 7.

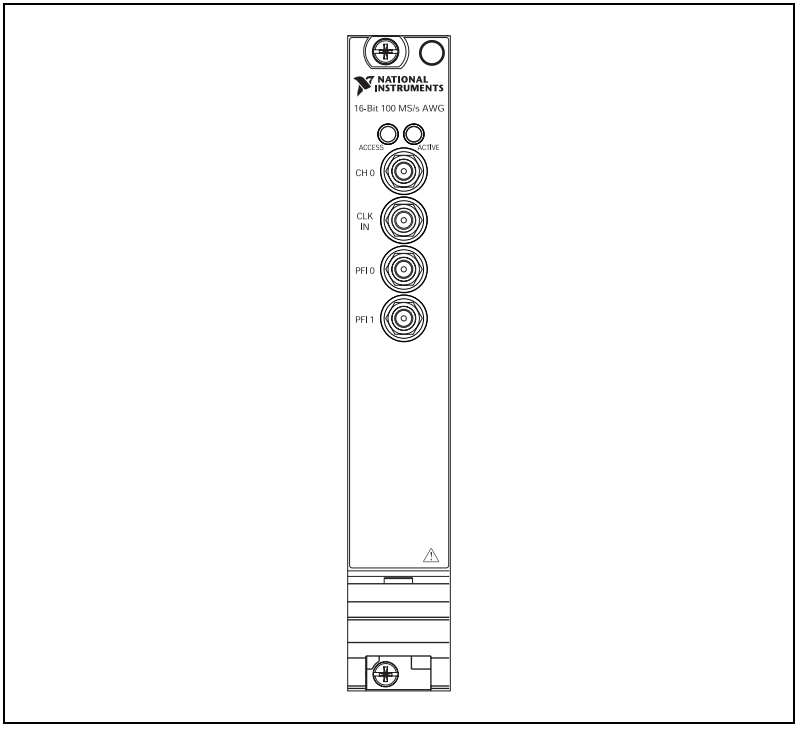


Figure 7. NI 54*xx* AWG Module Front Panel

Table 5. NI 54*xx* AWG Module Front Panel Connectors

Connector	Use
CH 0	Output terminal for an IF waveform for upconversion to the desired RF frequency. Connect to the IF INPUT connector on the NI 5610 front panel.
CLK IN	Output terminal for the AWG module reference clock signal. Connect to the REF OUT connector on the NI 5610 module front panel.
PFI 0	Bidirectional SMB connectors. As an input, the PFI terminals can accept a trigger from an external source to start or step through signal generation.
PFI 1	

Table 6. NI 54*xx* AWG Module Front Panel LEDs

LED	Indications
ACCESS	Indicates the basic hardware status of the NI 54*xx* AWG module. This LED functions identically to the ACCESS LED on the NI 5610 upconverter module front panel. OFF—The module is not yet functional or has detected a problem with a power rail. AMBER—The module is being accessed. GREEN—The module is ready to be programmed.
ACTIVE	Indicates the state of the NI 54*xx* AWG module. OFF—The module is not armed or triggered. AMBER—The module is armed and waiting for a Start trigger. GREEN—The module has received a Start trigger and is generating a waveform. RED—The module has detected an error state; this may indicate PLL unlocking, self-test failure, or calibration failure.

NI 565*x* RF Signal Generator Module

The NI 565*x* RF signal generator module front panel contains two connectors and two multicolor LEDs, as shown in Figure 8.

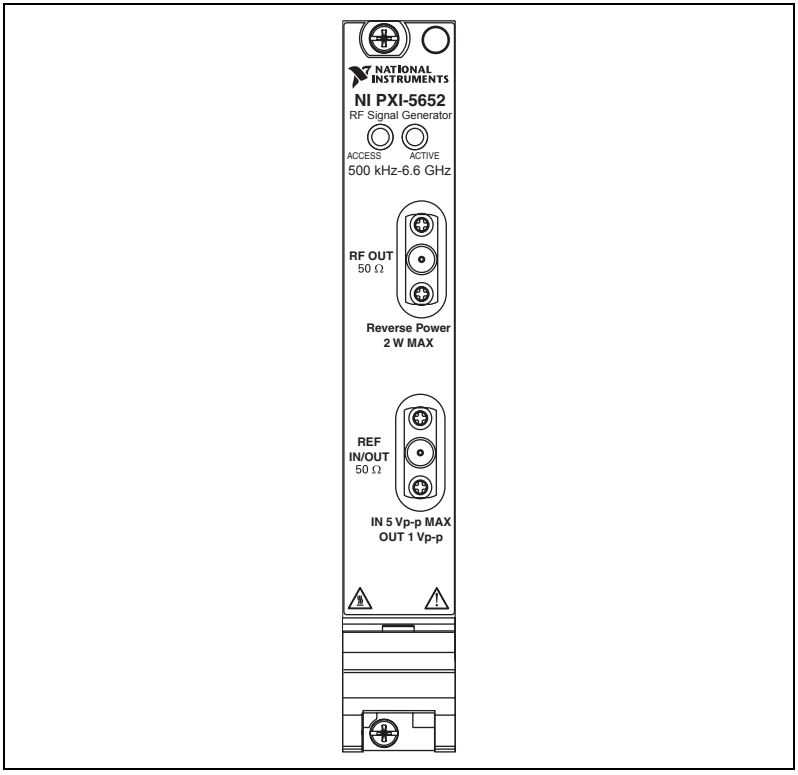


Figure 8. NI 565*x* RF Signal Generator Module Front Panel

Table 7. NI 565*x* RF Signal Generator Module Front Panel Connectors

Connector	Use
RF OUT	Output terminal for the RF signal at the requested frequency and power level.
REF IN/OUT	Routes a frequency reference signal to or from the NI 565x. This connector can be configured as an external frequency reference input or as an output for the onboard 10 MHz reference clock.

Table 8. NI 565*x* RF Signal Generator Module Front Panel LEDs

LED	Indications
ACCESS	Indicates the basic hardware status of the NI 565*x* module. OFF—The module is not yet functional or has detected a problem with a PXI power rail. AMBER—The module is being accessed. GREEN—The module is ready to be programmed.
ACTIVE	Indicates the status of the NI 565*x*. OFF—The module is in an uninitialized state; there is no error. AMBER—The module PLLs are attempting to lock. GREEN—The module is generating a signal; applicable PLLs are locked. RED—The module has detected an error state; this may indicate lock failure in an applicable PLL, a self-test or calibration failure, or a thermal shutdown condition.

Appendix B: Building a Basic NI-RFSG Application

Complete the following steps in LabVIEW to build a basic NI-RFSG application for generating continuous sine wave signals:

1. Select **Start**»**All Programs**»**National Instruments**»***<LabVIEW>***» **LabVIEW** to launch LabVIEW. The LabVIEW screen appears.
2. Click **New**, choose **Blank VI**, and click **OK** to create a blank VI.
3. Display the block diagram by clicking it or by selecting **Window**» **Show Block Diagram**.
4. Activate the LabVIEW context help by pressing <Ctrl-H>.
5. Navigate to the NI-RFSG VIs on the **Functions**»**Measurement I/O**» **NI-RFSG** palette.
6. Create the block diagram shown in Figure 9 by wiring the five VIs on the block diagram in the order in which they appear in the top row of the NI-RFSG Functions palette.

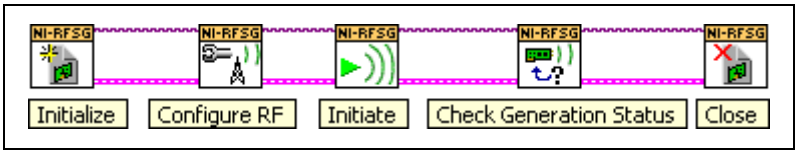


Figure 9. Basic NI-RFSG Block Diagram

7. Hover the cursor over the **resource name** terminal on the niRFSG Initialize VI and right-click. Select **Create»Control** to create a front panel control where you specify the RF signal generator device name. The **resource name** terminal is shown in Figure 10.

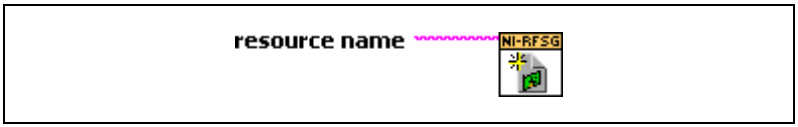


Figure 10. Resource Name Terminal on niRFSG Initialize VI

8. Hover the mouse tool over the **frequency (Hz)** and **power level (dBm)** terminals of the niRFSG Configure RF VI. These terminals are shown in Figure 11.

Figure 11. Frequency and Power Level Terminals on the niRFSG Configure RF VI

9. Right-click each terminal and select **Create»Control** from the shortcut menu to create frequency and power controls as shown in Figure 12.

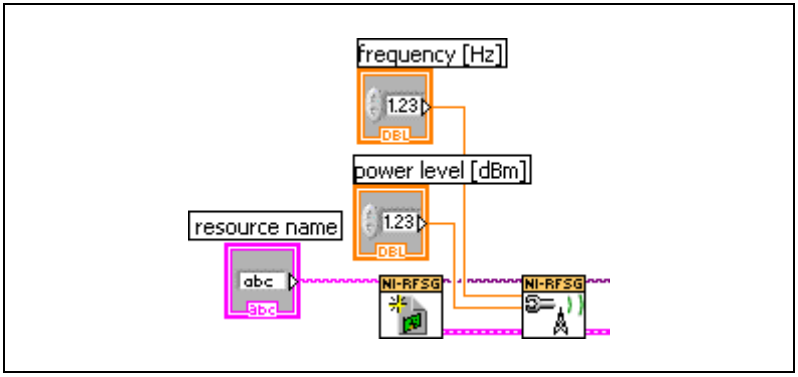


Figure 12. Frequency and Power Level Controls on the Block Diagram

10. Display the VI front panel by clicking it or by selecting **Window» Show Front Panel**. Controls are displayed in which you can specify a frequency and power level.
11. In the VI front panel **power level (dBm)** control, enter `0`. In the **frequency (Hz)** control, enter `100M` (100 MHz).

12. In the VI front panel **resource name** control, enter the NI 5610 upconverter device name or the NI 565*X* device name that you specified in MAX (the NI 5610 upconverter module must be associated with an AWG module. Refer to section *8. Configuring the NI 565x in MAX* for more information.).

You can control continuous waveform generation using a **Stop** button. A **Stop** button is typically used within a While Loop. This example places a While Loop around the Check Generation Status VI so that signal generation continues and waveform status is continuously checked until you click STOP.

Build a STOP button by completing steps 13 through 17.

13. Display the block diagram by clicking it or selecting **Window» Show Block Diagram**.
14. Select the While Loop on the **Functions**»**Programming**»**Structures** palette.
15. Enclose the niRFSG Check Generation Status VI in the While Loop, as shown in Figure 13.

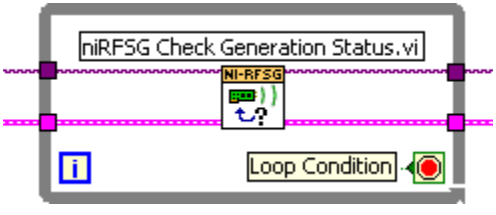


Figure 13. Enclose niRFSG Check Generation Status VI in the While Loop

16. Hover the mouse over the While Loop tunnels and select **Replace with Shift Register**.
17. Select the Unbundle by Name primitive on the **Functions**» **Programming**»**Cluster & Variant** palette. Place the primitive inside the While Loop.
18. Wire the **error out** terminal of the niRFSG Check Generation Status VI to the Unbundle by Name primitive.
19. Wire the output terminal of the **status** element to the **Loop Condition** terminal of the While Loop using a logical Or gate.
20. Right-click the unused input terminal of the Or gate **Loop Condition** terminal and select **Create**»**Control** to create a STOP button on the VI front panel. The portion of the block diagram resulting from steps 17 through 20 is shown in Figure 14.

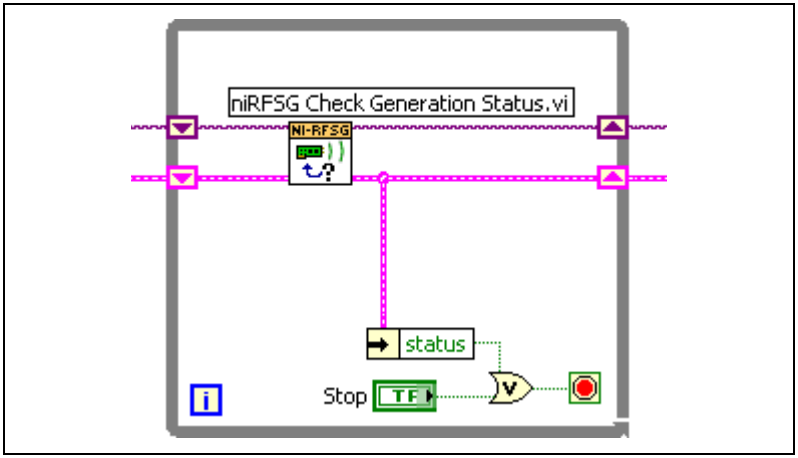


Figure 14. While Loop with STOP Button

Complete steps 21 and 22 to add an error indicator to the VI front panel.

21. Create an error indicator by right-clicking the **error out** terminal of the niRFSG Close VI and selecting **Create»Indicator**. The **error out** terminal is highlighted in Figure 15.

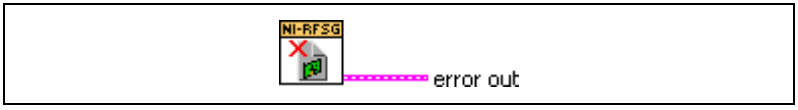


Figure 15. Error Out Terminal on niRFSG Close VI

22. Verify that the VI block diagram now looks like the example in Figure 16.

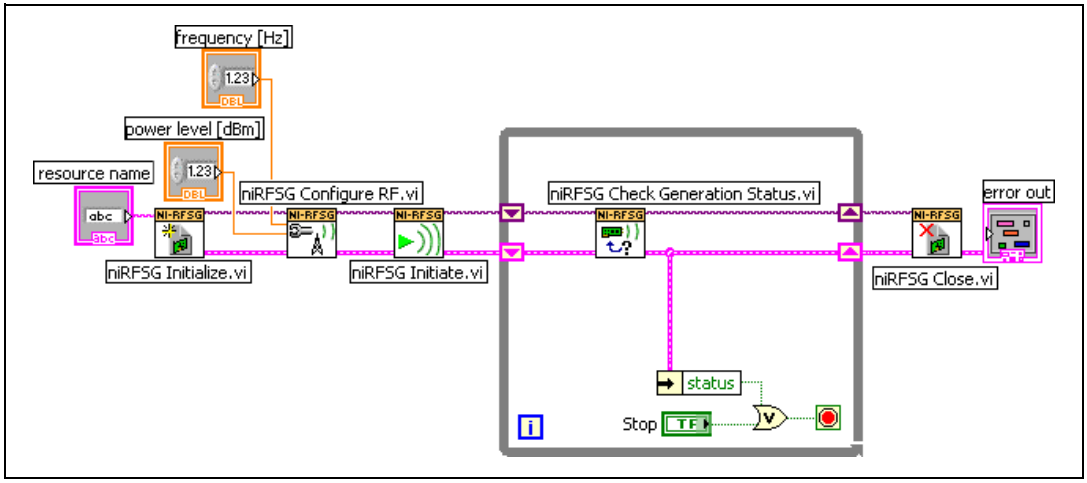


Figure 16. Basic Sine Wave Generation VI Block Diagram

23. Verify that the VI front panel looks like the example in Figure 17.

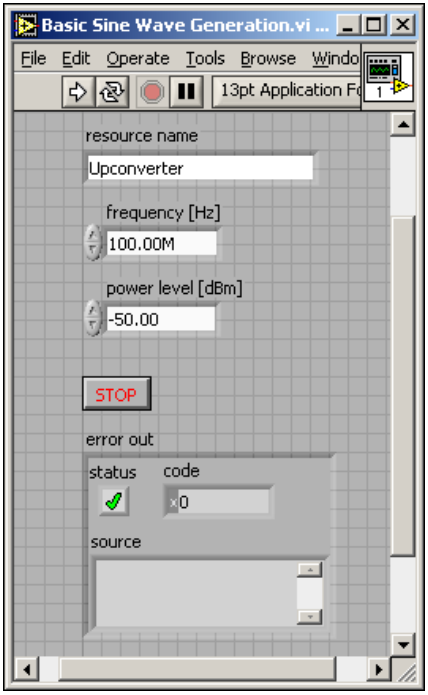


Figure 17. Basic Sine Wave Generation VI Front Panel Using NI 567*X*

Note Populate the **resource name** control with the NI 5610 upconverter module name (refer to the *Rename Both Modules* section for more information) or the NI 565*x* name specified in MAX.

24. Click the **Run** icon on the VI taskbar to initiate sine wave generation.

25. Click the VI front panel **STOP** button to stop sine wave generation.

Caution Always stop VI operation using the front panel STOP button you created.

Never stop a VI with the ABORT button on the taskbar. The ABORT button does not free memory resources and leaves hardware and software in an unknown state.

You have successfully generated a continuous sine wave signal using the NI-RFSG driver software and the RF signal generator hardware.

Appendix C: Troubleshooting

Module Front Panel ACCESS LED is Off When PXI Chassis is On

If the ACCESS LED fails to light after you power on the PXI chassis, a problem may exist with the PXI power rails, a hardware module, or the LED.

Note The LEDs may not light until the device has been configured in MAX. Before proceeding, verify that the RF signal generator module(s) appear in MAX.

Troubleshoot this issue by completing the following steps:

1. Power off the PXI chassis.
2. Disconnect any signals from the PXI module front panels.
3. Remove any module front panel connections from the RF signal generator hardware module(s).
4. Remove the RF signal generator hardware and inspect for damage. Do *not* reinstall a damaged device.
5. Reinstall the RF signal generator in different PXI slot(s). Use the procedure detailed in section *5. Installing the Hardware* for more information.
6. Power on the PXI chassis.
7. Verify that the RF signal generator module(s) appear in MAX.
8. Reset the RF signal generator module(s) in MAX and perform a self-test. Refer to section *7. Configuring the NI 567x in MAX* or *8. Configuring the NI 565x in MAX* for information on performing device resets and self-tests in MAX.
9. If either ACCESS LED still fails to light, and failures continue, contact NI technical support or visit `ni.com/support`.

Hardware Module Does Not Appear in MAX

Use the following procedure if an RF signal generator hardware module does not appear in MAX:

1. In the MAX Configuration pane, click **Devices and Interfaces** to expand the category.
2. Click **NI-DAQmx Devices** folder and press <F5> to refresh the list of installed devices.
3. If an RF signal generator module is still not listed, power off the system, ensure that all RF signal generator hardware is correctly installed, and restart the system.

4. Open the Windows Control Panel and select **System»Hardware» Device Manager**. Complete the appropriate step for the setup:
   - If using a PXI controller, verify that a **National Instruments** entry appears in the system device list. Reinstall NI-RFSG and the RF signal generator hardware modules if error conditions are present in the list.
   - If using a MXI-3 controller, right-click **PCI-to-PCI Bridge** and select **Properties** from the shortcut menu to verify that the bridge is enabled.
5. If either module still fails to appear in the MAX **NI-DAQmx Devices** folder, contact NI technical support or visit `ni.com/support`.

Module Fails the Self-Test

The MAX self-test performs a brief test of device resources. If an RF signal generator hardware module does not pass the self-test, complete the following steps:

1. Reboot the system.
2. Launch MAX and perform the self-test again. If the module still fails the self-test, proceed to step three.
3. Uninstall the NI-RFSG driver software using the Add/Remove Programs option on the Windows Control Panel. Never attempt to uninstall by deleting files.
4. Reinstall NI-RFSG by running `setup.exe` on the NI-RFSG CD.
5. If either module still fails the self-test, contact NI technical support or visit `ni.com/support`.

Thermal Shutdown Error

The thermal shutdown error appears when device temperatures exceed safe limits. The RF signal generator shuts down until temperatures fall to acceptable levels and you reset the device in MAX.

To re-enable the RF signal generator after thermal shutdown, complete the following steps:

1. Power down the chassis that contains the device.
2. Review the procedure in the section titled *Cooling* and make any necessary adjustments to ensure that the device is effectively cooled.
3. Call `niRFSG_ResetDevice` (NI-RFSG Reset Device VI) or perform a device reset in MAX. The thermal shutdown error continues to be reported until the device has been successfully reset.

Note Refer to section *7. Configuring the NI 567x in MAX* or *8. Configuring the NI 565x in MAX* for information on performing device resets in MAX.

Performance Issues Using A MXI Connection

When using a MXI-3 connection to control the PXI chassis, you must run the MXI Optimization Application prior to using the NI signal generator. By default, this application runs automatically when Windows starts. Using a MXI connection without running this application may result in a `time exceeded` or `internal software error`, or an initialization, timeout, or performance issue when using an RF signal generator.

For MXI-3 optimization, select **Start»All Programs»National Instruments MXI-3»MXI-3 Optimization**. MXI-4 optimization is performed automatically by the MXI-4 hardware.

If the MXI software is not installed, refer to the setup instructions included with the MXI kit to install the software from the MXI software CD or *National Instruments Driver CD*. After installation, you may be required to reboot the computer before using the MXI application.

If you continue to have initialization or performance issues, refer to the MXI documentation included in your MXI kit, or visit NI Technical Support at `ni.com/support`.

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